Nathan M. Urban
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Computational Physics and Methods (CCS-2)
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RESEARCH INTERESTS

Probabilistic climate and impacts prediction; coupled natural-economic-energy systems; Bayesian uncertainty and learning; adaptive risk management; Earth system feedbacks, nonlinearities, and thresholds; ice sheets and sea level rise; climate-carbon cycle dynamics; paleoclimate.

METHODS

Earth system models; perturbed physics ensembles; Bayesian parameter estimation; statistical emulators; economic integrated assessment models.

EDUCATION

2006, **Ph.D., Physics**, Pennsylvania State University
2006, **M.Ed., Physics**, Pennsylvania State University
1997, **B.S., Physics**, Virginia Tech
1997, **B.S., Computer Science**, Virginia Tech
1997, **B.S., Mathematics**, Virginia Tech

PROFESSIONAL EXPERIENCE

2011–present, **Energy Security Fellow**, Los Alamos National Laboratory, Energy Security Center
2010–2011, **Postdoctoral Research Fellow**, Princeton University, Woodrow Wilson School of Public and International Affairs
2009–2010, **Research Associate**, Penn State, Geosciences
2007–2009, **Postdoctoral Scholar**, Penn State, Geosciences
2000–2006, **Graduate Research Assistant**, Penn State, Physics
1999–2005, **Graduate Teaching Assistant**, Penn State, Physics
1997–1999, **Software Developer**, InSystems Technologies (Roanoke, VA)

PUBLICATIONS

Peer-reviewed:

1. R.L. Sriver, N.M. Urban, R. Olson, and K. Keller, "Towards a physically plausible upper

bound of sea-level rise projections", in review (2012).

2. C.M. Little, M. Oppenheimer, and N.M. Urban, "A probabilistic assessment of upper bounds on 21st century Antarctic ice loss", in revision (2012).

3. C.M. Little, N.M. Urban, and M. Oppenheimer, "A comprehensive, probabilistic framework for assessing ice sheet contribution to sea level change", in review (2012).

4. T.W. Hilton, K.J. Davis, K. Keller, and N.M. Urban, "Improving terrestrial CO2 flux diagnosis using spatial structure in land surface model residuals". Biogeosciences Discussions **9**, 7073 (2012), in review.

5. R. Olson, R.L. Sriver, M. Haran, W. Chang, N.M. Urban, and K. Keller, "Uncertainty in climate sensitivity estimates due to realizations of unresolved climate noise", in revision (2012).

6. T.E. Fricker, J.E. Oakley, and N.M. Urban, "Multivariate emulators with nonseparable covariance structures", *Technometrics* (2012), in press.

7. R. Olson, R. Sriver, M. Goes, N.M. Urban, H.D. Matthews, M. Haran, and K. Keller, "A climate sensitivity estimate using Bayesian fusion of instrumental observations and an Earth System model", *Journal of Geophysical Research–Atmospheres* **117**, D04103 (2012).

8. P.J. Applegate, N.M. Urban, K. Keller, T.V. Lowell, B.J.C. Laabs, M.A. Kelly, and R.B. Alley, "Improved moraine age interpretations through explicit matching of geomorphic process models to cosmogenic nuclide measurements from single landforms", *Quaternary Research* **77**, 293 (2012).

9. A. Schmittner, N.M. Urban, J.D. Shakun, N.D. Mahowald, P.U. Clark, P.J. Bartlein, A.C. Mix, and A. Rosell-Mel, "Climate sensitivity estimated from temperature reconstructions of the Last Glacial Maximum", *Science* **334**, 1385 (2011).

10. Y. Cui, L.R. Kump, A.J. Ridgwell, A.J. Charles, C.K. Junium, A.F. Diefendorf, K.H. Freeman, N.M. Urban, and I.C. Harding, "Slow release of fossil carbon during the Paleocene-Eocene Thermal Maximum", *Nature Geoscience* **4**, 481 (2011).

11. J. Xiao, K.J. Davis, N.M. Urban, K. Keller, and N. Saliendra, "Upscaling carbon fluxes from towers to the regional scale: Influence of parameter variability and land cover representation on regional flux estimates", *Journal of Geophysical Research—Biogeosciences* **116**, G03027 (2011).

12. M. Goes, N.M. Urban, R. Tonkonojenkov, M. Haran, and K. Keller, "The skill of different ocean tracers in reducing uncertainties about projections of the Atlantic meridional overturning circulation", *Journal of Geophysical Research—Oceans* **115**, C12006 (2010).

13. N.M. Urban and K. Keller, "Probabilistic hindcasts and projections of the coupled climate, carbon cycle, and Atlantic meridional overturning circulation systems: A Bayesian fusion of century-scale observations with a simple model", *Tellus A* **62**, 737 (2010).

14. N.M. Urban and T.E. Fricker, "A comparison of Latin hypercube and grid ensemble designs for the multivariate emulation of a climate model", *Computers & Geosciences* **36**, 746 (2010).

15. P.J. Applegate, N.M. Urban, K. Keller, and R.B. Alley, "Modeling the statistical distributions of cosmogenic exposure dates from moraines", *Geoscientific Model Development* **2**, 1407 (2010).

16. A. Schmittner, N.M. Urban, K. Keller, and D. Matthews, "Influence of ocean vertical mixing on future climate and carbon cycle projections", *Global Biogeochemical Cycles* **23**, GB4009 (2009).

17. N.M. Urban and K. Keller, "Complementary observational constraints on climate sensitivity", *Geophysical Research Letters* **36**, L04708 (2009).

18. D.E. Shai, N.M. Urban and M.W. Cole, "Structure and heat capacity of Ne and Xe adsorbed on a bundle of carbon nanotubes from Monte Carlo calculations", *Phys. Rev. B* **77**, 205427 (2008).

19. N.M. Urban, S.M. Gatica, M.W. Cole, and J.L. Riccardo, "Thermodynamic properties and correlation functions of Ar films on the surface of a bundle of nanotubes", *Phys. Rev. B* **71**, 245410 (2005).

In submission/review/revision:

20. N.M. Urban, T.J. Bralower, M. Haran, and K. Keller, "A statistical interpretation of surface ocean temperature trends during the Paleocene-Eocene Thermal Maximum", in revision (2012).

21. C.M. Little, M. Oppenheimer, and N.M. Urban, "A probabilistic, bottom-up approach to ice sheet driven sea level rise projections", in revision (2012).

22. R.L. Sriver, N.M. Urban, R. Olson, and K. Keller, "Towards a physically plausible upper bound of sea-level projections", in revision (2012).

Non-peer reviewed (conference proceedings, etc.):

23. M. Haran and N.M. Urban, "Discussion of 'A statistical analysis of multiple temperature proxies: are reconstructions of surface temperatures over the last 1000 years reliable?' by McShane and Wyner", *Annals of Applied Statistics* **5**, 61 (2011).

24. N.M. Urban and M.W. Cole, "Quantum fluids in nanopores", *Int. J. Mod. Phys. B* **20**, 5264 (2006).

25. D.M. Ricciuto, R. Tonkonojenkov, N.M. Urban, R.D. Wilkinson, D. Matthews, K.J. Davis, and K. Keller, "Assimilation of oceanic, atmospheric, and ice core observations into an Earth system model of intermediate complexity", *Global Biogeochemical Cycles* (2011).

In preparation:

26. N.M. Urban, "Historic and future learning about climate sensitivity".

27. N.M. Urban, "The effect of sulfate aerosol forcing uncertainty on estimates of climate sensitivity".

28. R. Fuller, N.M. Urban, P.J. Applegate, and K. Keller, "How uncertain are decadal scale predictions of global mean sea level rise?".

FUNDING

Co-Investigator:
"Integrated assessment of climate and landscape change in the Southeast United States", USGS

Senior Personnel (Co-Investigator, subcontract):
"Characterizing the deep uncertainty surrounding forecasts of interacting climate stressors", NSF prime (RAND subcontract to Penn State)

Collaborator:
"Influence of disturbance and seasonality on regional carbon flux upscaling", NASA

WORKSHOPS

1. Participant: 17th Annual CESM Workshop. Breckenridge (CO), June 18–21 (2012).

2. Invited participant: Stochastic Flows and Climate Modeling. Aspen Center for Physics (ACP), Aspen (CO), June 11-22 (2012).

3. Invited participant: Uncertainty Quantification Methodology Workshop. Statistical and Applied Mathematical Sciences Institute (SAMSI), Research Triangle Park (NC), September 7–10 (2011).

4. Invited speaker: Climate Uncertainty Quantification Workshop. Statistical and Applied Mathematical Sciences Institute (SAMSI), Pleasanton (CA), August 28–September 1 (2011).

5. Participant: First International Workshop on Climate Informatics. New York Academy of Sciences, New York (NY), August 26 (2011).

6. Visiting Fellow: Mathematical and Statistical Approaches to Climate Modelling and Prediction. Isaac Newton Institute for Mathematical Sciences, Cambridge University (UK), September 4–27 (2010).

7. Invited participant: Probabilistic Climate Prediction (satellite meeting of the Isaac Newton Institute for Mathematical Sciences). University of Exeter (UK), September 20–23 (2010).

8. Invited participant: Probability and Uncertainty in Climate Modelling (PUCM) Research Playground. Durham University (UK), February 11–March 21 (2008).

9. Participant: National Science Foundation Nanoscale Interdisciplinary Research Team (NSF/NIRT) workshop. Harvard University, November 29 (2004).

SERVICE AND PUBLIC IMPACT

Climate sensitivity research highlighted in M. Inman, "A sensitive subject", *Nature Reports Climate Change* (30 April 2009).

Grant review panelist for U.S. Department of Energy (DOE).

Reviewer for *Climatic Change Letters*, *Journal of Climate*, *Journal of Geophysical Research*, *Geophysical Research Letters*, and *Earth System Dynamics*.

Public outreach: Gave 4-part blog interview ("This Week's Finds 302–305") on Azimuth Blog (by Prof. John Baez of UC Riverside Mathematics Dept.); see links at `http://www.azimuthproject.org/azimuth/show/Nathan+Urban`.

Public outreach: Gave blog interview on Planet 3.0 blog (`http://newscience.planet3.org/2011/11/24/interview-with-nathan-urban-on-his-new-paper-climate-sensitivity-estimated-from-temperature-reconstructions-of-the-last-glacial-maximum/`).

Public outreach: Speaker at Thomas Jefferson High School for Science and Technology Symposium to Advance Research (tjSTAR). Talk: "Climate uncertainty, learning, and policy", Alexandria (VA), June 1 (2011).

TEACHING/EDUCATION ACTIVITIES

2006, **Master of Education in Physics** (higher education specialization), Penn State
Topic: "Constructivist and Inquiry-Based Science Education".
Coursework: Higher Education in the U.S., Curricula in Higher Education

2010, **Instructor/Curriculum Design**, Penn State

Created, developed, and was primary instructor of a 1-credit (pass/fail) workshop on Bayesian statistical methods, attended by ∼20 graduate students, postdocs, faculty, undergraduates, and visiting international scientists.

1997, **Instructor/Curriculum Design**, Virginia Tech

Created, developed, instructed, and graded a 3-credit (pass/fail) upper-level undergraduate physics course on general relativity.

2006–2009, **Substitute Lecturer**, Penn State

Gave substitute or guest lectures in three undergraduate (The Earth System, Introductory Physics, Sound and Light) and three graduate courses (Data Analysis in the Earth Sciences, Climate Change, Math Methods) in geosciences and physics.

2006, **Teaching Assistant (volunteer)/Curriculum Design**, Penn State

Assisted in the development of a new physics course (acoustics/optics for education majors). Volunteer teaching assistant.

1999–2005, **Graduate Teaching Assistant**, Penn State

Supervised traditional and collaborative group-oriented student recitations for introductory physics students.

1996–1997, **High School Student Mentor**, Virginia Tech

AWARDS AND HONORS

2005, *David C. Duncan Graduate Fellowship*
(Department of Physics, Penn State)

1997, *Lubna R. Ijaz Scholarship for Physics and Service*
(Department of Physics, Virginia Tech)

PRESENTATIONS

1. 17th Annual CESM Workshop. Presenter, Invited talk: "Uncertainty quantification in stochastic climate models", Breckenridge (CO), June 20 (2012).

2. SAMSI Climate Uncertainty Quantification Workshop. Presenter, Invited talk (canceled due to weather): N.M. Urban, "Climate uncertainty and learning", Pleasanton (CA), August 30 (2011).

3. Pacific Northwest National Laboratory / Joint Global Change Research Initiative (PNNL/JGCRI). Presenter, Invited talk: N.M. Urban, "Climate uncertainty and learning", College Park (MD), March 14 (2011).

4. Los Alamos National Laboratory. Presenter, Invited talk: N.M. Urban, "Climate uncertainty and learning", Los Alamos (NM), February 9 (2011).

5. 3rd North American Carbon Program (NACP) All-Investigators Meeting. Accepted poster: K.J. Naithani, K.J. Davis, N.M. Urban, K. Keller, J. Xiao, P. Bolstad, D. Hua, "Upscaling

carbon fluxes and uncertainty across the northern forest ecoregion using a hierarchical Bayesian approach", New Orleans (LA), January 31–February 4 (2011). Presenter: K. Naithani.

6. American Geophysical Union (AGU) Fall Meeting. Poster: C.M. Little, M. Oppenheimer, N. Urban, "Moving beyond ice loss scenarios for Antarctica", San Francisco (CA), December 13–17 (2010). Presenter: C. Little.

7. American Geophysical Union (AGU) Fall Meeting. Poster: Y. Cui, L. Kump, A. Ridgwell, C. Junium, A.F. Diefendorf, K.H. Freeman, N. Urban, "Carbon addition during the Paleocene-Eocene Thermal Maximum: Model inversion of a new, high-resolution carbon isotope record from Svalbard", San Francisco (CA), December 13–17 (2010). Presenter: Y. Cui.

8. American Geophysical Union (AGU) Fall Meeting. Poster: M.P. Goes, N. Urban, K. Keller, A. Schmittner, R. Tonkonojenkov, M. Haran, "Using ocean tracers to reduce uncertainties about ocean diapycnal mixing and model projections", San Francisco (CA), December 13–17 (2010). Presenter: M. Goes.

9. American Geophysical Union (AGU) Fall Meeting. Poster: A.J. Terando, S. Bhat, M. Haran, K. Hayhoe, K. Keller, N. Urban, "Developing regionally downscaled probabilistic climate change projections for the Southeast Regional Assessment Project", San Francisco (CA), December 13–17 (2010). Presenter: A. Terando.

10. 3rd USGS Modeling Conference. Talk: A.J. Terando, K.S. Bhat, M. Haran, K. Hayhoe, K. Keller, N. Urban, "Developing regionally downscaled probabilistic climate change projections for the Southeast Regional Assessment Project", Broomfield (CO), June 7–11 (2010). Presenter: A. Terando.

11. European Geosciences Union (EGU) General Assembly. Poster: R. Tonkonojenkov, M. Goes, N.M. Urban, H.D. Matthews, and K. Keller, "Skill of Bayesian parameter estimation methods: A case study with key climate model parameters", Vienna (Austria), May 2–7 (2010). Presenter: R. Tonkonojenkov.

12. American Geophysical Union (AGU) Fall Meeting. Presenter, Poster: N.M. Urban, T.J. Bralower, K. Keller, and L.R. Kump, "Statistical interpretation of the rate of carbon isotope changes at the onset of the Paleocene-Eocene Thermal Maximum", San Francisco (CA), December 14–18 (2009).

13. American Geophysical Union (AGU) Fall Meeting. Submitted abstract: P. Applegate, N. Urban, B. Laabs, and R. Alley, "The skewnesses of small data sets: simple model experiments in cosmogenic exposure dating of moraines", San Francisco (CA), December 14–18 (2009).

14. American Geophysical Union (AGU) Fall Meeting. Submitted abstract: J. Xiao, K.J. Davis, N. Urban, and K. Keller, Regional upscaling of eddy flux measurements in the

Upper Midwest, U.S.A.: Influence of land cover heterogeneity and model parameterization on regional carbon flux estimates", San Francisco (CA), December 14–18 (2009).

15. American Geophysical Union (AGU) Fall Meeting. Submitted abstract: T.W. Hilton, K.J. Davis, K. Keller, and N.M. Urban, "Improving surface flux estimates with model-data fusion and multiple data constraints", San Francisco (CA), December 14–18 (2009).

16. American Geophysical Union (AGU) Fall Meeting. Invited talk: K.J. Davis *et al.*, "Model-data fusion at scales from site to globe: Uncertainty assessment, network design and multiple data constraints", San Francisco (CA), December 14–18 (2009). Presenter: K. Davis.

17. AGU Chapman Conference on Abrupt Climate Change. Poster: P.J. Applegate, N.M. Urban, T.V. Lowell, and R.B. Alley, "Effects of sampling criteria on the distributions of exposure dates from degrading moraines", Ohio State, June 15–19 (2009). Presenter: P. Applegate.

18. European Geosciences Union (EGU) General Assembly. Presenter, Talk: N.M. Urban and K. Keller, "Probabilistic hindcasts and projections of the coupled climate, carbon cycle, and Atlantic meridional overturning circulation systems", Vienna (Austria), April 19–24 (2009).

19. European Geosciences Union (EGU) General Assembly. Poster: M. Goes, K. Keller, N.M. Urban, R. Tonkonojenkov, J. Dorin, and A. Schmittner, "What is the skill of different ocean tracers to reduce uncertainties about model projections of the North Atlantic Meridional Overturning Circulation?", Vienna (Austria), April 19–24 (2009). Presenter: M. Goes.

20. European Geosciences Union (EGU) General Assembly. Poster: P.J. Applegate *et al.*, "Inferring moraine age and depth of glacial erosion from cosmogenic exposure dates using geomorphic process modeling", Vienna (Austria), April 19–24 (2009). Presenter: P. Applegate.

21. Northeastern Geological Society of America (GSA) 44th Annual Meeting. Poster: P.J. Applegate, N. Urban, M.A. Kelly, T.V. Lowell, and R.B. Alley, "Unifying cosmogenic exposure dating and cosmogenic geomorphology with process modeling", Portland (ME), March 22–24 (2009). Presenter: P. Applegate.

22. 2nd North American Carbon Program (NACP) All-Investigators Meeting. Plenary talk: Y. Luo, N.M. Urban, K.J. Davis, K. Keller, P. Thornton, M. Post, and E. Weng, "Assimilation of multiple, heterogeneous data sets to enhance predictability of future carbon sink dynamics in the North America terrestrial ecosystems", San Diego (CA), February 17–20 (2009). Presenter: Y. Luo.

23. American Geophysical Union (AGU) Fall Meeting. Talk: T.J. Bralower, K. Keller, and N. Urban, "Statistical analysis of climate and biotic variability during the Paleocene Eocene Thermal Maximum", San Francisco (CA), December 15–19 (2008). Presenter: T. Bralower.

24. American Geophysical Union (AGU) Fall Meeting. Poster: T.W. Hilton, K.J. Davis, K. Keller, and N.M. Urban, "Spatial structure in North American regional carbon dioxide fluxes evaluated with a simple land surface model", San Francisco (CA), December 15–19 (2008). Presenter: T. Hilton.

25. Energy, Environment and Water Research Centre and Max Planck Institute for Chemistry "Climate Change: Causes and Impacts" Autumn School. Poster: R. Tonkonojenkov, D.M. Ricciuto, N. Urban, R.D. Wilkinson, H.D. Matthews, K. Keller, and K.J. Davis, "Estimating joint likelihood of two key biochemical parameters in an Earth system model", Paphos (Cyprus), October 12–19 (2008). Presenter: R. Tonkonojenkov.

26. Probability and Uncertainty in Climate Modelling (PUCM) "Research Playground" workshop. Presenter, Talk: "Two climate models", Durham University (UK), February 11–March 21 (2008).

27. Managing Uncertainty in Complex Models (MUCM) "Multivariate Theme Day" workshop. Presenter, Talk: "Two climate models", Aston University (UK), March 5 (2008).

28. 13th International Conference on Recent Progress in Many-Body Theories. Talk: N.M. Urban and M.W. Cole, "Quantum fluids in nanopores", University of Buenos Aires (Argentina), December 5–9 (2005). Presenter: M. Cole.

29. National Science Foundation Nanoscale Interdisciplinary Research Team (NSF/NIRT) workshop. Presenter, Talk: "Thermodynamic properties and correlation functions of Ar films on the surface of a bundle of nanotubes", Harvard University, November 29 (2004).